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13. ABSTRACT (Maximum 200 words) The project provided state-of-the-art training to students on the use of modern field and laboratory equipment in Environmental Science, Chemistry and Biology enabling students to apply their new knowledge and skills on analyzing environmental problems, and educating students on the benefits of using an interdisciplinary approach to solve environmental problems. Investigators of this grant have successfully concluded courses involving field and laboratory instruction in Environmental Science, Chemistry, and Biology during the past 1998-99 academic year at the University of the Incarnate Word. Dr. Sara Kerr, Biology provided training on field use of the Global Positioning system (GPS) equipment and on the application of ARCVIEW for development of maps at selected study sites. Dr. William F. Thomann, Environmental Science provided instruction on field and laboratory studies of water quality of the San Antonio River on the UIW campus, and chemical data assessment by computer analysis using standard software. Dr. S. Bin Kong, Chemistry has set up and used the Gas Chromatograph Mass Spectrometer for water quality studies. The project resulted in the development of new research courses in Environmental Science, Chemistry, and Biology, and improved programmatic changes involving educational research in the Sciences. Science faculty will continue to develop an integrated approach in educational research by setting up field and laboratory projects that include research components in Environmental Science, Geology, Chemistry, and Biology.			
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Final Progress Report

Introduction

Laboratory and field instruction for undergraduate students in Biology, Chemistry, and Environmental Science was greatly strengthened through the incorporation and application of newly acquired state-of-the-art field and laboratory instruments which provided increased capability for field mapping, employment of new analytical skills for water quality assessment, enhanced training on computer modeling and data evaluation, and application of interdisciplinary approaches for environmental research projects.

The overall goal of the project was 1) to prepare the students of the University of the Incarnate Word (UIW) to excel in the Natural Sciences by providing them with the types of facilities they will use in their professional careers, and 2) to contribute to the economies of San Antonio and Texas. In order to accomplish the overall goal, funds were used to acquire Environmental Protection Agency (EPA) approved instrumentation and support technology that will enhance student experience in biology, chemistry, and environmental science laboratories offered to undergraduate students. As result of a learning environment that includes the opportunity to gather and analyze data using the best available equipment, students integrate the knowledge acquired from their science courses. The program provided students with the interdisciplinary education required for today's complex environmental issues.

The scientific personnel supported by this project include Dr. William F. Thomann (PI), Environmental Science, Dr. S. Bin Kong (Co-PI), Chemistry, and Dr. Sara F. Kerr, Biology. This final technical report is divided into three sections with summaries provide by Dr. William F. Thomann (PI) for the Environmental Science component, Dr. S. Bin Kong (Co-PI) for the Chemistry component, and Dr. Sara F. Kerr for the Biology component. Investigators of this grant have purchased and used the equipment required for field and laboratory instruction in Environmental Science, Chemistry, and Biology during the Fall 1998 and Spring 1999 semesters at UIW. This equipment includes the following:

Biology -Four Trimble Pathfinder ProXPR and two Pathfinder Pro XRS Global Positioning Systems; Dell latitude (laptop) computers; Pathfinder Office, ESRI ArcView, High Performance Systems STELLA II, and Office 97 software; and stream flow, dissolved oxygen, temperature, conductivity, and salinity meters.

Chemistry - Gas chromatograph (GC) mass spectrometer with associated accessories, atomic absorption spectrophotometer supplies and High Pressure Liquid Chromatography (HPLC).

Environmental Science - SMART colorimeters (spectrophotometers), Dell latitude (laptop) computers, Bexar County Soil Maps, Geologic maps of the San Antonio area, USGS 7.5' Quadrangle topographic maps of San Antonio and surrounding areas, binocular stereomicroscopes, software for groundwater flow analysis and water chemistry.

Education and Undergraduate Research Accomplishments

This program was designed to meet the needs and goals identified by a task force of faculty in various disciplines who teach science courses that are required of the environmental science major. The needs addressed by this program are:

- 1) Revised the undergraduate environmental science curriculum;
- 2) Upgraded technology to meet EPA standards;
- 3) Integrated technology use in courses in ecology, chemistry, and environmental science;
- 4) Provided authentic research experience for students in the environmental science program.

Environmental Science

Dr. Thomann taught an Environmental Science Research course (ENSC 4371) that involved undergraduate field and laboratory research on soils, and a study of the physical properties of and chemistry of the San Antonio River on the University of the Incarnate Word campus during the Spring 1999 semester. This course was offered in conjunction with the field research course taught by Dr. Sara Kerr who provided instruction on field methods in ecology that included the use and application of Global Positioning System (GPS) equipment for accurate location of study sites and data acquisition. Environmental Science and Biology majors learned how to use the portable LaMotte SMART® Colorimeters and YSI® Dissolved Oxygen/pH/Temperature/Conductivity meters purchased from this grant for chemical studies of the San Antonio River. Environmental Protection Agency (EPA) field methods of surface water sampling and testing protocols were followed and selected water samples were brought back to the laboratory for further analysis. Students measured stream velocity at various locations along the river using Swoffer® flow meters, and each student measured cross-sectional areas to calculate stream discharge.

Students worked on four selected projects on soils, stream discharge and flood frequency, groundwater studies, and surface water studies of the San Antonio River (see syllabus, Appendix I). The set up and procedures used by students throughout the course are presented on exercises and handouts (see Appendix I for selected examples). Due to time constraints, greater emphasis was placed on mapping and water quality studies of the San Antonio River. Water quality assessment included data analysis using AQUACHEM® software for water type classification, chemical trend analysis, and identification of any chemical constituents above EPA recommended limits.

Students used standard EPA watershed survey techniques to collect data for comparison with previous USGS data available electronically. Data was analyzed and presented with bar graphs, and piper and stiff diagrams. The students reported no significant contaminants in the water from the San Antonio River except for above normal concentrations of nitrate and phosphate which appear to come from fertilizers washed in from recent rains from a golf course located a few miles upstream from the study area.

Future work will include field and laboratory studies of groundwater flow and chemistry of the Edwards Aquifer in which students will develop strategies on data analysis and interpretation based on field and laboratory data collection, and analysis of environmental impact and risk assessment due to potential contaminants in the groundwater.

Biology

GPS consultant Karen Steede-Terry conducted a GPS workshop attended by Biology and Environmental Science Faculty and Media Center Personnel. The GPS systems with the supporting laptops and hardware were made available through the media center for student use in their courses. Component parts of the GPS systems were color coded to prevent equipment loss.

Dr. Sara Kerr, Associate Professor of Biology, introduced a new upper division Biology course entitled special Topics: Field Research in Environmental Science (see BIOL 4399/ENSC 4371.1 syllabus, Appendix II). Emphasis was placed on the application of Global Positioning System technology to the assessment and monitoring of the environment. Students made GPS maps of the vegetation, roads, walkways, and utilities of the UIW campus that were then overlaid onto GIS maps downloaded from the internet (see Class Project Map, Appendix II).

Field trips to area Air Force facilities enhanced student understanding of the practical application of equipment use. At Kelly Air Force Base, students learned how a plume of contaminated ground water is being contained and monitored. Students also visited Brooks Air Force Base, where they met with Geographic Information system personnel.

During the coming year, the GPS equipment; stream flow meters; and dissolved oxygen, temperature, conductivity, and salinity meters will be used in Ecology (BIOL 3442) and Aquatic Biology (BIOL 4482) laboratories. By Fall 2000, a three hour course will be added that is entirely dedicated to the application of GIS and GPS to field studies in the environmental and biological sciences.

Chemistry

Dr. S. Bin Kong attended three workshops and one conference in the use of the GC mass spectrometer and HPLC. The session attended were:

January, 1999. GC-Mass Training I, Shimadzu Instrumentation Co, Columbia, Maryland.

April, 1999. Analytical Chemistry and Spectroscopy Pittsburgh Conference seminar,
Orlando, Florida.

May, 1999. GC-Mass Training II, Shimadzu Instrumentation Co, Columbia, Maryland.

July, 1999. HPLC Training, Shimadzu Instrumentation Co, Columbia, Maryland.

In the Spring of 1999, Dr. Beth Colburn, Assistant Professor of Chemistry taught a course in instrumental analysis which utilized the HPLC. Students in the course Used HPLC to analyze the amount of caffeine in sodas and coffees, and to perform forced degradation studies on caffeine. The HPLC was used by the students in independent research projects. One group analyzed capsaicin amounts in different types of hot sauces. Course syllabus for Instrumental Analysis – CHEM 4322 and sample laboratory procedures for the instrumental analysis course can be found in Appendix III.

Two students participated in a chemistry research course during the summer of 1999. The project required the use of analysis using the analytical equipment provided by the grant. During the fall of 1999, five students will participate in individual research projects using the GC Mass Spectrometer or the HPLC to collect data. The syllabus for student projects in Chemistry Research is in Appendix III. The chemistry department has plans to use the HPLC to enhance the laboratory curriculum in the Quantitative analysis course. GC Mass Spectrometer training will be included in the next offering of the instrumental analysis course.

Support Courses

A variety of students are enrolled in courses that support the environmental science major. Because of the collaborative relationships of the faculty in biology, chemistry, and environmental science, students in introductory and lower division courses have and will benefit from the use of the technology acquired by the grant. Dell Laptop computers have been used in the introductory biology class to demonstrate evolutionary systems and to analyze climate data to investigate the hypothesis of global warming. The GPS/GIS systems enhance student research into emerging disease in South Texas by providing a method for tracking and mapping trap sites of rodents and insect vectors. Students in the general ecology course will use the STELLA ecological modeling software as part of the laboratory curriculum. Organic Chemistry students will use the spectrometers in laboratory investigations.

Outcomes of the Program

First order outcomes of the program were:

- 1) Participants became proficient in the use of EPA approved technology;
- 2) Students improved their computer skills;
- 3) Students applied their skills in technology use to real world problems.

Student projects and lab experiences completed in the courses that utilized DOD funded technology provide evidence that students attained these outcomes. Training in equipment use was provided to the students enrolled in the target courses. Data acquisition and analysis was enhanced through the use of the laptop computers. Student projects in the Ecology and Environmental Science courses provided the opportunity for the students to apply their newly acquired skills to mapping habitats and assessing water quality.

Second order outcomes included:

- 1) Provided students with skills necessary for the advanced courses in the curriculum sequence;
- 2) Students acquired skills that could be used in the workplace;
- 3) Increased student employment opportunities in the field of environmental science;
- 4) Prepared students to apply for graduate programs;
- 5) Future increased enrollment in the environmental science program by providing students with superior training.

Students gained skills that may be applied in capstone research courses and in the workplace. The training in use of cutting edge technology should enhance the job opportunities for student participants as well as increase interest in the environmental science program at UIW. However, due to the short-term nature of the program, it is not possible to evaluate these outcomes.

Third order outcomes were:

- 1) Increase the number of underrepresented students in the environmental science field;
- 2) Further the civilian use of DOD technology.

As a minority institution, UIW trains minority students in many fields. There is the potential for increasing the number of graduates with degrees in Environmental Science. Training and application GPS and GIS technology for ecological mapping and modeling promotes the civilian use of DOD positioning satellites.

The program activities and outcomes are summarized in Diagram 1 – Flow Chart of Curriculum Outcomes and Diagram 2 – Flow Chart of Technology Outcomes on the following two pages.

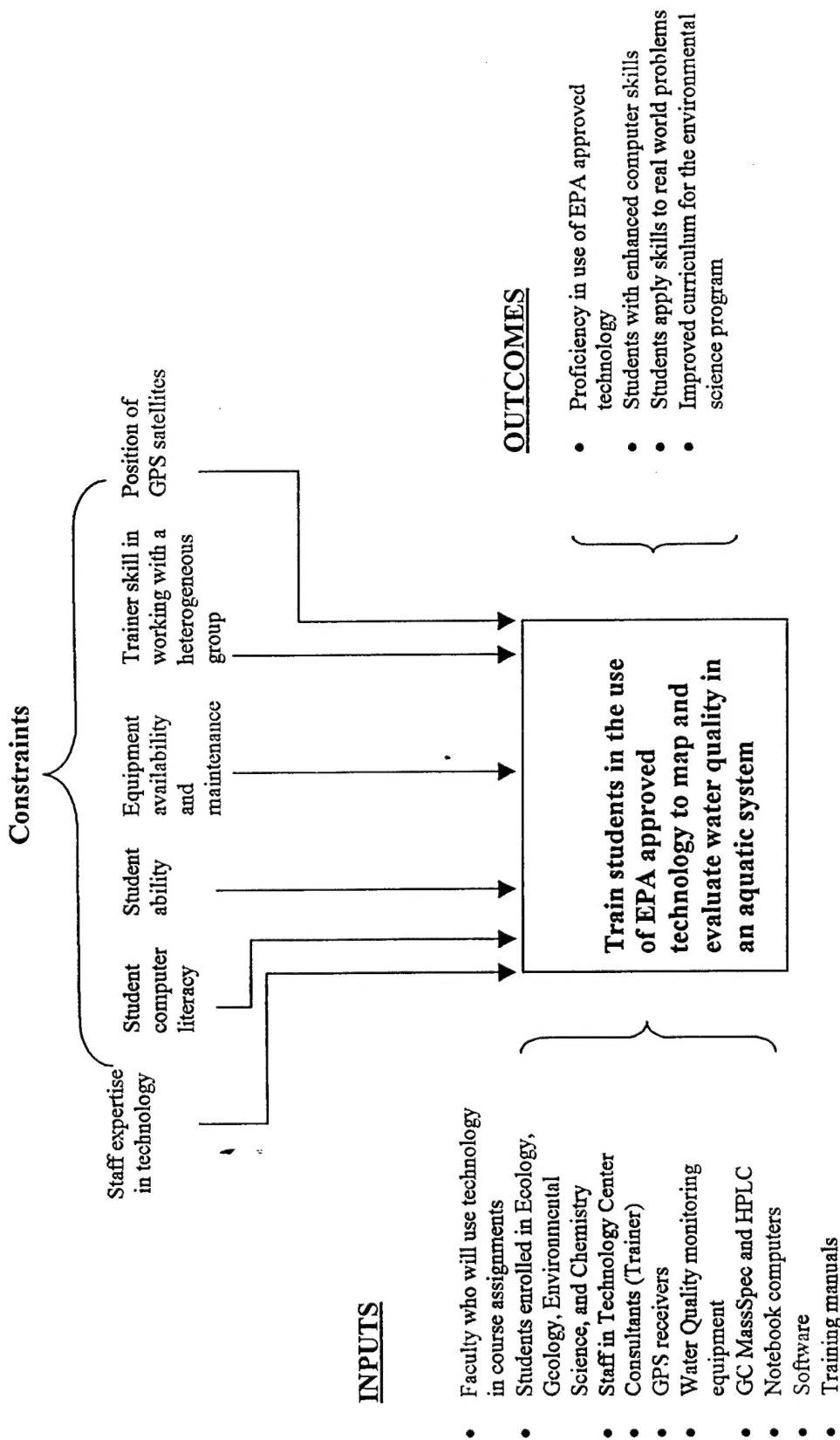


Diagram 1 – Flow Chart of Curriculum Outcomes

Constraints

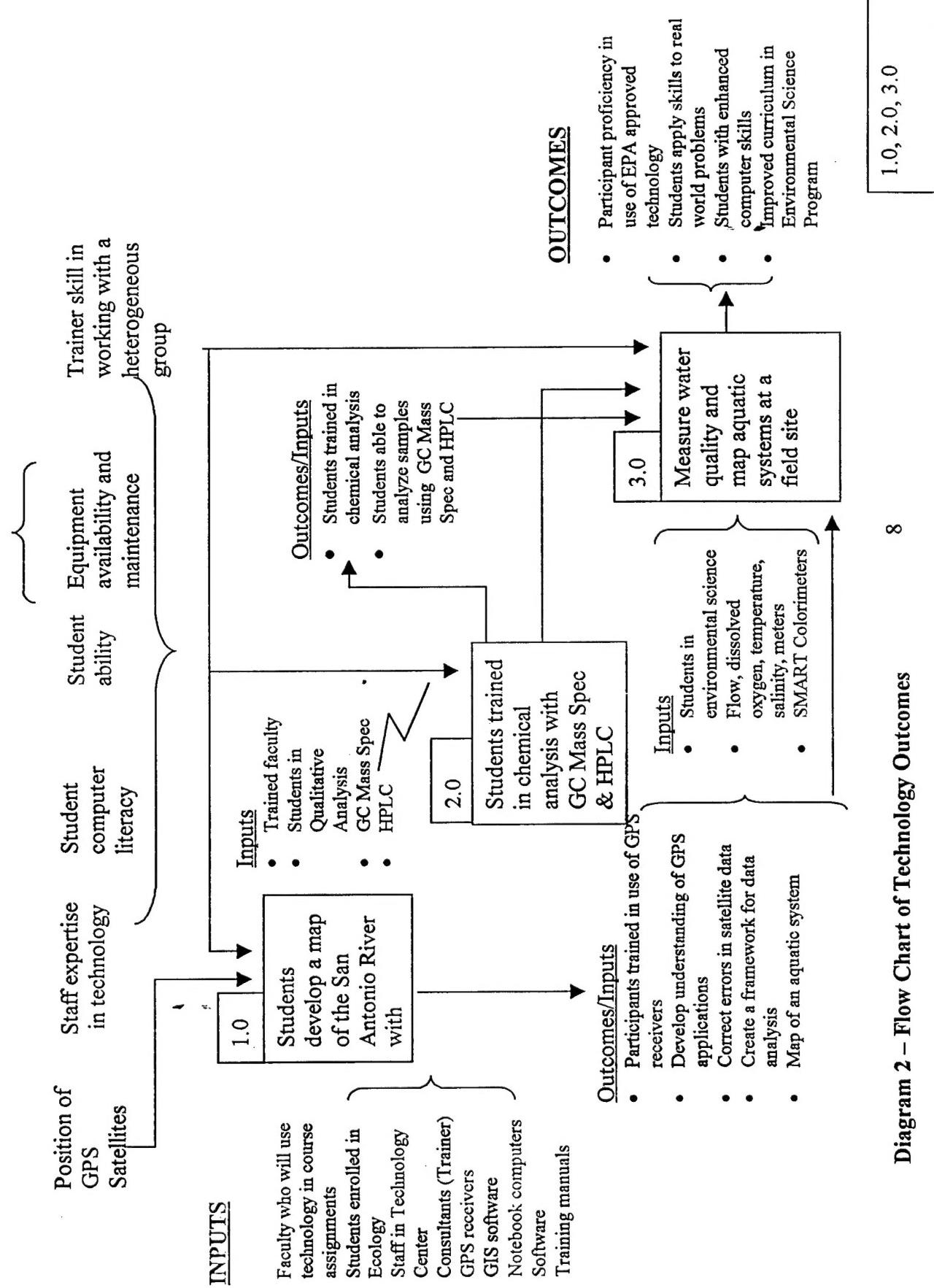


Diagram 2 – Flow Chart of Technology Outcomes

Appendix I

Laboratory Research in Environmental Science Syllabus – ENSC 4371.2

Examples of Analytical Techniques and Procedures used in Water Quality Studies

UNIVERSITY OF THE INCARNATE WORD
Research in Environmental Science - Laboratory - Special Topics ENSC 4371
Course Syllabus

Catalogue Description: See page 175 of the University of the Incarnate Word 1997-99 Undergraduate Bulletin. This course is only offered for upper-level Biology, Chemistry, and Environmental Science majors.

Prerequisites: One year of introductory Biology courses and one year of introductory Chemistry courses.

Specifications: Environmental Science Research is an optional upper-level science course strongly recommended for Biology, Chemistry, and Environmental Science majors who wish to learn about analytical methods used in surface and groundwater studies, groundwater flow and contaminant flow modeling, aqueous geochemistry and modeling, and soil analysis including measurement of engineering soil properties. The course partially fulfills part of the course elective requirements for Environmental Science majors. The course can be repeated for up to a maximum of 6 credit hours. Course audience is meant for junior through senior level. Sophomores who have completed the Biology and Chemistry prerequisites may sign up for this course only upon approval of the Coordinator of Environmental Science.

Course Description : Environmental Science Research is an upper-level course which deals with laboratory and field methods used in surface and groundwater studies. The laboratory component includes training on the use of various kinds of research equipment used for analysis of inorganic constituents in water, aqueous geochemical modeling, groundwater flow and contaminant transport modeling, and the measurement of various physical and engineering properties of soils. The field component includes EPA-recommended methods of water sampling and analysis in streams, lakes, and ponds, measurement of stream discharge, in-situ measurements of various soil properties, and in-situ measurements of hydraulic conductivity, sorptivity, and matric flux potential in the vadose zone. This course requires an understanding of basic principles in geology, physics, chemistry, and mathematics. Knowledge of Calculus I is helpful but a firm background in Algebra is necessary to understand specialized groundwater concepts. Students will be required to participate in assigned class and field projects, and turn in completed assignments to partially fulfill course requirements. Cognitive and thematic elements include studies of inorganic contaminants in surface and groundwater and their possible sources, rates of dispersion of inorganic contaminants in surface and groundwater, and the ultimate fate of inorganic contaminants in surface and groundwater.

Course Outcomes : Students will : 1. learn how to properly operate a dissolved oxygen/temperature/conductivity/salinity meter and a portable spectrophotometer for analysis of inorganic constituents in water samples, 2. set up and run 2-dimensional and 3-dimensional groundwater models using Dell Latitude 233 computers , 3. set up and run aqueous geochemical models 4. calculate groundwater discharge and flow, 5. operate a Guelph permeameter and tensiometer, and 6. handle and operate soil sampling equipment and learn how to assess the physical and hydraulic properties of soils. Theoretical concepts and field applications will ultimately enable students make informative decisions regarding environmental issues on surface and groundwater pollution, and soil contamination.

University of the Incarnate Word
Spring 1999
Special Topics - ENSC-4371
Research in Environmental Science - Laboratory

Instructor: Dr. William F. Thomann

Office: Room 208, Science Hall ; phone# 829-3972

Lecture Schedule: Monday and Wednesday, 11:55AM to 1:10PM, Room SH306

Office Hours: 9:00AM - 10:00AM Monday and Wednesday; 1:00PM - 2:00PM on Tuesday and Thursday. Please see me for setting up appointments at other times.

Lecture Text: Notes on concepts and theory will be given out in class.

Laboratory Text: Handouts on laboratory exercises will be given out each lab period.

Prerequisite: Junior or Senior standing, and one year of biology courses and one year of chemistry courses

Research in Environmental Science is a Special Topics course which deals with laboratory water quality studies including aqueous geochemical modeling, field investigations of surface water and groundwater including a laboratory component on groundwater flow modeling and contaminant transport, and a study of physical and engineering properties of soils. The course is interdisciplinary in nature in that it deals with the application of chemical, geological, mathematical, and engineering concepts to examine environmental issues related to water quality in surface water, groundwater, and soils, and to assess the environmental impact and potentially adverse degradation to the environment due to contaminated water and soil. This course will include: 1. hands-on training on the proper use of laboratory equipment that includes a LaMotte SMART Colorimeter (spectrophotometer), a YSI Dissolved Oxygen /Temperature/ Conductivity /Salinity meter, Kelway soil moisture and pH meter, soil test kits, 2. aqueous geochemical modeling and groundwater flow modeling using Dell Latitude 233 computers, 3. laboratory study of physical and engineering soil properties, 4. field training on water sampling and analysis, soil sampling and analysis, 5. field training on the use of a Guelph permeameter/infiltrometer for determination of hydraulic conductivity, sorptivity, and matric flux potential in the vadose zone. There will also be a study of stream hydrology of the San Antonio River, and an introduction to land-use planning that will include site selection for community or industry development. Selected case histories will be studied on a variety of environmental issues.

All students must participate on all class projects throughout the semester. All research projects require spending considerable time in the laboratory and in the field, and a schedule must be worked out among team members to coordinate duties of each person and to set up a weekly schedule. Class notes and handouts on a variety of environmental science topics will be provided to all students, and at least 2 hours will be set aside each week to discuss theoretical concepts, demonstrate the use of various types of equipment, and to advise, make recommendations, and answer any questions on current research projects. The grade in the course will be based upon five research projects. Attendance and class assignments (if any) will be considered in the final grade, especially borderline cases. Grades will be awarded according to the regulations specified in the current Undergraduate Bulletin of the University of the Incarnate Word. Please keep all of your graded research papers and assignments in the event there is a question concerning your grade in the course.

Student conduct and academic honesty : Please refer to page 54 in the 1995-97 UIW Undergraduate Bulletin for statements regarding student conduct at UIW. In the current UIW Student Handbook, refer to pages 7 to 8 regarding class attendance, pages 8 to 11 regarding code of academic integrity, and pages 85 to 91 regarding the Joint Statement on Rights and Freedoms of Students.

Reference textbooks for Research in Environmental Science course

Environmental Science, 4th ed., by Jonathan Turk and Amos Turk, Saunders College Publishing, 1988, 712p.

Environmental Geology, 3rd ed., by Carla W. Montgomery, W.C. Brown Publishers, 1992, 466p.

Environmental Geology, 6th edition, by Edward A. Keller, (1992), Macmillan Publishing Co., 521p.

Essentials of Soil Mechanics and Foundations by David F. McCarthy, Reston Publishing Co., Inc., (A Prentice Hall Co.), 1977, 505p.

Geology and the Environment, by Bernard W. Pipkin, West Educational Publishing, 1994

General Geology for Engineers, by Alan E. Kehew, Prentice-Hall, Inc., 1988, 447p.

Principles of Engineering Geology, by Robert B. Johnson and Jerome V. DeGraff, John Wiley & Sons, Inc., 1988, 497p.

Soil Survey of Bexar County, Texas by F.B. Taylor, R.B. Hailey, and D.L. Richmond, U.S. Department of Agriculture, Soil conservation Service, Series 1962, No. 12, 1966, 126p.

Stream Hydrology, An Introduction for Ecologists by Nancy D. Gordon, Thomas A. McMahon, and Brian L. Finlayson, John Wiley & Sons, Inc., 1992, 526 p.

Volunteer Stream Monitoring: A Methods Manual, EPA 841-B-97-003. U.S. Environmental Protection Agency, Office of Water, Washington D.C. 20460, 1997, 210 p.

Any other geology, geological engineering, soils, geohydrology, and environmental science textbooks.

Environmental Science Research Projects

The instructor will provide assignments and all materials required for all research projects. Please read over the assigned material prior to each activity to be better prepared for each activity and raise any questions you may have on the subjects. Slides and short films on selected topics may be presented to augment the subjects.

Week of:

Project

January 13 to 15

Properties of Soils

January 18 to 22

a. sieve analysis

January 25 to 29

b. porosity and permeability, chemical tests

c. engineering properties

Paper is due on February 1, 1999.

Paper counts 20% of course grade.

February 1 to 5, 8 to 12

Stream Discharge and Flood Frequency

February 8 to 12

a. stream discharge measurements

b. flood frequency calculations

Paper is due February 15, 1999.

Paper counts 20% of course grade.

February 15 to 19

Groundwater Flow, Groundwater

February 22 to 26

Contamination

March 1 to March 5

a. self-paced instruction module with two

exercises by Paul F. Hudak on analyzing a
groundwater-flow field and analyzing a
groundwater contamination problem

b. exercise on determining groundwater
contamination by Paul L. Garvin

Paper is due on March 8, 1999.

Paper counts 20% of course grade.

March 8 to 12
March 22 to 26
March 29 to 31, April 1, 2

Field Exercise in Geohydrology:
Guelph Permeameter and Tensiometer
a. Guelph Permeameter
b. Tension Infiltrometer
c. Pressure Infiltrometer

Paper is due on April 5, 1999.
Paper counts 20% of course grade.

April 5 to 9
April 12 to 16
April 19 to 23
April 26 to 30

Surface Water and Groundwater Analysis, Water Equilibria - Computer Modeling, 2-Dimensional Groundwater Flow Modeling and Particle Tracking, Land-Use Planning

Paper is due on May 3, 1999.
Paper counts 20% of course grade.

Name _____

Research in Environmental Science - Laboratory
Special Topics - ENSC 4371
Water Chemistry

This project involves a water chemistry study of portions of the Olmos Creek, San Antonio River, and the "Blue Hole" which is part of the San Antonio Springs. The work you will perform is an extension and continuation of the previous stream discharge study of the San Antonio River, except that you will be sampling and chemically analyzing the river and springs for potential contaminants. The following equipment will be used in the field: 1. YSI Model 85 - Dissolved Oxygen, Conductivity, Salinity, and Temperature Meter, and the LaMotte SMART Colorimeter. Operation manuals are provided for each instrument, and make sure you understand the operation and use of these instruments thoroughly before you go out into the field. Both instruments are calibrated so that you will not need to change any of the settings. A separate handout with simplified instructions including a data sheet will be provided for the YSI meter. The Operator's Manual for the LaMotte SMART Colorimeter contains instructions on the operation of the colorimeter and instructions on the preparation of water samples and analysis of various inorganic constituents.

You will collect water samples and analyze them for the following:

1. YSI meter - dissolved O₂, conductivity, salinity, and temperature
2. LaMotte SMART Colorimeter -

<u>Element</u>	<u>Range (ppm)</u>
K ⁺	1 - 10
[PO ₄] ⁻²	0 - 80 (high range)
total Fe	0 - 6 (phenanthroline)
total Mn	0 - 10 (high range)
total Cr	0 - 1.0 (hexavalent)
S ⁻²	0 - 3.0
F ⁻¹	0 - 20.0
Si ⁺⁴	0 - 4.0 (low range)
[NO ₃] ⁻¹	0 - 3.0
Al ⁺³	0 - 0.3
Zn ⁺²	0 - 3.0
Cu ⁺²	0 - 5.0
[SO ₄] ⁻²	0 - 100.0
NH ₃	0 - 3.0
Cl ⁻¹	0 - 4.0

3. pH meter

Use the conversions for the following:

$$4.4 \times [\text{Nitrate - Nitrogen}] = [\text{NO}_3]^{-1}$$

$$1.2 \times [\text{Ammonia - Nitrogen}] = \text{NH}_3$$

$$2.23 \times \text{Cr}^{+6} = (\text{CrO}_4)^{-2}$$

If $[\text{SO}_4]^{-2}$ is greater than 100 ppm, then dilute with deionized water and multiply reading by dilution factor.

Write your report following the Outline for Writing a Science Research Paper that you used for your previous report on stream discharge. You have been given several handouts on methods of surveying the study site, methods of water collection and analysis, quality control, interpretation of chemical results, and methods of data presentation. The report must include the following:

1. A completed form on "Watershed Survey Visual Assessment." This is a four page form.
2. A completed form on "Stream Habitat Walk", a completed map on "Sketch of site", and a completed form on "Physical Characterization"(skip the Macroinvertebrate Survey portion of this form)
3. Follow instructions on data presentation including graphs, tables, and figures.

Chemical Analysis of Stream Water Samples
Data Sheet

Site Location _____ Site No. _____

Date _____ Time _____

Weather conditions: for outside measurements in streams, lakes, ponds, wells

Temperature _____ °C Sky conditions _____

Relative Humidity _____ % Barometric pressure _____ "Hg

Instruments: LaMotte SMART Colorimeter and pH meter

Analytical Results (ppm)

K⁺ _____ Si⁺⁴ _____ Cl⁻¹ _____

total Fe _____ Zn⁺³ _____ [PO₄]⁻² _____

total Mn _____ Cu⁺² _____ [NO₃]⁻² _____

total Cr _____ S⁻² _____ [SO₄]⁻² _____

Al⁺³ _____ F⁻¹ _____ NH₃ _____

pH _____

Dissolved Oxygen/Conductivity/Salinity/Temperature Meter

YSI Model 85

Basic Operation

I. Membrane installation for Dissolved Oxygen probe

- A. If the membrane and solution are not already installed, then follow instructions from page 5 of the instruction manual; replace membrane and solution once a month

II. Calibration of Dissolved Oxygen

- A. Make sure the sponge inside the calibration chamber is wet (distilled water only)
- B. Turn instrument on and press MODE button to DO in % or mg/L, and wait 15 minutes to stabilize
- C. Press and release both UPARROW and DOWNARROW simultaneously
- D. Enter local elevation and press ENTER once
- E. The lower left display should show CAL, and the calibration value should be displayed in the lower right of the display. The current % reading (before calibration) should be on the main display. Make sure that the current % reading (large display) is stable, then press the ENTER button. The display should read - SAVE- and then should return to the Normal Operation Mode.

All calibrations should be completed at a temperature which is as close as possible to the sample temperature.

III. Calibration of Conductivity - perform every six months.

IV. Advanced Conductivity Setup - not required

Dissolved Oxygen/Conductivity/Salinity/Temperature Meter
Data Sheet

Site Location _____

Site No. _____

Date _____

Time _____

Weather conditions: for outside measurements in streams, lakes, ponds, wells

Temperature _____ °C Sky conditions _____

Relative Humidity _____ % Barometric pressure _____ "Hg

Dissolved Oxygen _____ % Dissolved Oxygen _____ mg/L

Conductivity _____ µS or mL
(°C not flashing)

Specific Conductance _____ µS or mL
(°C flashing)

Salinity _____ ppt

Clean instrument and conductivity cell after each use according to procedures in Operations Manual.

$$\text{Specific Conductance} = \frac{\text{Conductivity}}{(1 + 0.0191)(T - 25^\circ\text{C})}$$

Name _____

Research in Environmental Science - Laboratory
Special Topics - ENSC 4371
Water Chemistry - Geochemical Data Analysis and Plotting

This laboratory activity involves plotting water chemical data of the San Antonio River onto a variety of graphs, identifying chemical characteristics and trends, and interpreting the geochemical data. The software *AquaChem®* will be used to plot the water chemistry data.

I. Start up the *AquaChem®* program on the laptop computer, and run the tutorial to learn the setup and operation of this program.

II. Set up a file for each water chemistry data set of the San Antonio River. Enter the data you collected from water analyses performed using the Lamotte Colorimeter®, YSI Dissolved Oxygen-Conductivity-Salinity-Temperature Meter, and pH meter. Use these data for one file setup. Enter the data on water chemistry from analyses performed by the U.S. Geological Survey, and set this information up as a second file.

III. Plot your water chemistry data and the USGS data onto the following graphs:

1. Piper
2. Durov
3. Schoeller
4. Radial
5. Stiff

Use different symbols to distinguish between the data you have collected and the USGS data.

IV. Classify the water types for your data and the USGS data, and notes any characteristic features and chemical trends.

V. Examine the Drinking Water Regulations Report for each of the sets of data and record the ionic species and other parameters such as TDS which exceed the World Health Organization guide of drinking water requirements.

VI. Write a report summarizing your findings following the guidelines for "Outline for Writing a Science Research Paper." You may run off copies of the water chemistry graphs from III. to incorporate into your report. Make sure you explain each figure that you use in your report. Place all chemical data in the Appendix of your report.

Name _____

Selected Topics: Laboratory Research in Environmental Science - ENSC 4371
Stream Discharge

Objectives

- Measure the stream cross-sectional areas at five or more sites along the San Antonio River and Olmos Creek on the University of the Incarnate Word campus.
- Measure average stream velocities at the same sites where cross-sectional areas were measured using the *Swoffer®* flow meter, and measure the bankslopes with a clinometer at each site.
- Record the nature of the stream bottom at the measured sites such as rocky, sandy, bedrock, etc.; describe and explain differences in channel geometry at each site, and locate the thalweg
- Calculate discharge values for each of the sites and compare these values from upstream to downstream. Explain what these values mean and explain unusual values. For example, runoff from recent rainfall, groundwater input, springs, tributaries, and discharges from drain and sewer pipes may account for changes in discharge at each site. Does the discharge below the juncture of two tributaries equal the sum of the discharges from the separate tributaries ? If not, then explain why not.
- Construct a detailed map of the stream and construct stream cross-sections for the five sites
- Estimate the bankfull discharge at the channel near the Admissions Center.
- Find out the highest discharge that occurred during the flood of mid-October, 1998 near the Admissions Center and compare this result to the calculated bankfull discharge.
- Account for possible sources of error in all measurements, calculations, and graphical plots.

Field Work and Laboratory Work

- A. Examine five sites along the San Antonio River for measurement of cross-sectional areas in the stream bed. Write down the time and date of the field measurements and the weather conditions including rainfall (if any) from the past 24 to 48 hours. Note the locations of the five sites on the enlarged topographic map of the University of the Incarnate Word campus. Include in your locations a section along Olmos Creek, the stream formed by discharge from the Blue Hole, the channel at the bridge near the Admissions Center, and the channel near the bridge that runs over Hildebrand Avenue. Use the GPS equipment to precisely locate each of the five sites, and download field measurements and calculations into ARC-VIEW on the laptop computers for later data processing and basemap construction.
- B. At each of the five locations, measure the width of the stream from bank to bank. Measure every meter or half a meter the depth of the water, and record these data in table form. Measure the average velocity of the stream at each of the sites using the *Swoffer®* flow meter. Include an average velocity measurement above the deepest part of the stream (thalweg). At each site, make sure you make five or more velocity measurements midway between each subarea (velocity domain). Calculate discharge at each of the sites. Compare these values from upstream to downstream, and explain what these values mean.

Make a cross-section of the stream on graph paper similar to the previous exercise on Stream Discharge and Flood Frequency. Make sure you use the same horizontal and vertical scale for each of the graphs. Shade in with pencil the current level of the stream for each graph.

Determine the cross-sectional area of each stream based on the graphs you have constructed, and record this on a table.

- C. Record the nature of the stream bottom at the measured sites such as rocky, sandy, bedrock, etc., describe and explain differences in channel geometry at each site, and locate the thalweg on each cross-section. Construct a detailed map of the stream and include the location of the point bars, cut banks, riffles, pools, etc. Plot the thalweg on your basemap. Measure the bankslope at each site with a clinometer and record the measurements on a table.
- D. Determine the wetted perimeter of the channel at the Admissions Center site using your graph. Calculate the hydraulic radius of the stream channel at this site.
- E. Determine the bankfull discharge at the channel adjacent to the Admissions Center. Determine the slope (gradient) of the stream from the USGS San Antonio East 7½' Quadrangle. Use the Manning Equation to estimate velocity of the stream at bankfull discharge. Find out the highest discharges that occurred in various nearby tributaries during the flood of mid-October, 1998, and compare these values to the calculated bankfull discharge value at the Admissions Center.
- F. Write a report on your field research and include analysis and interpretation of all measurements, calculation, graphs. Account for possible sources of error in all measurements, calculations, and graphical plots. Follow the instructions for writing this report from a separate handout given to you in class.

Note: 1. Record all of your data in table form to simplify your data collection for analysis in the lab. Use the table setup in the exercise Stream Discharge and Flood Frequency as a guide to setting up your own tables. You may use spreadsheets or other convenient templates from Corel Word Perfect, MS Word, or other commercial software.

Note: 2. Possible (but not all) sources of error in making field measurements may include the following:

- a. velocity meter not properly aligned parallel to stream flow resulting in lower than actual velocity values
- b. making too few velocity measurements and too few depth measurements resulting in inaccurate determination of cross-sectional areas and inaccurate average velocity and discharge calculations
- c. wide variations in velocity measurements taken vertically and laterally in turbulent parts of the stream
- d. imprecise channel width and channel depth measurements

Appendix II

Field Research in Environmental Science Syllabus – ENSC 4371.1/BIOL 4399

Class Project Map from Field Research in Environmental Science Course

University of the Incarnate Word
Spring 1999
Selected Topics: Field Research in Environmental Science
BIOL 4399/ENSC 4371.1

Instructor: Dr. Sara Kerr

Office: Science Hall 209

Telephone: 8293155

Office Hours: Tuesday/Thursday 2-4 PM, and by arrangement

Text: Environmental Protection Agency Risk Assessment Guidance for Superfund Volume II: Environmental Evaluation Manual; Introduction to GPS.

Catalogue Description: None

Prerequisite: One year of introductory Biology courses.

Context: Intended for upper division Biology, Chemistry and Environmental Science majors, or graduate students. Examines environmental issues of most relevance to this region, the agencies responsible for environmental protection, and current environmental assessment methods.

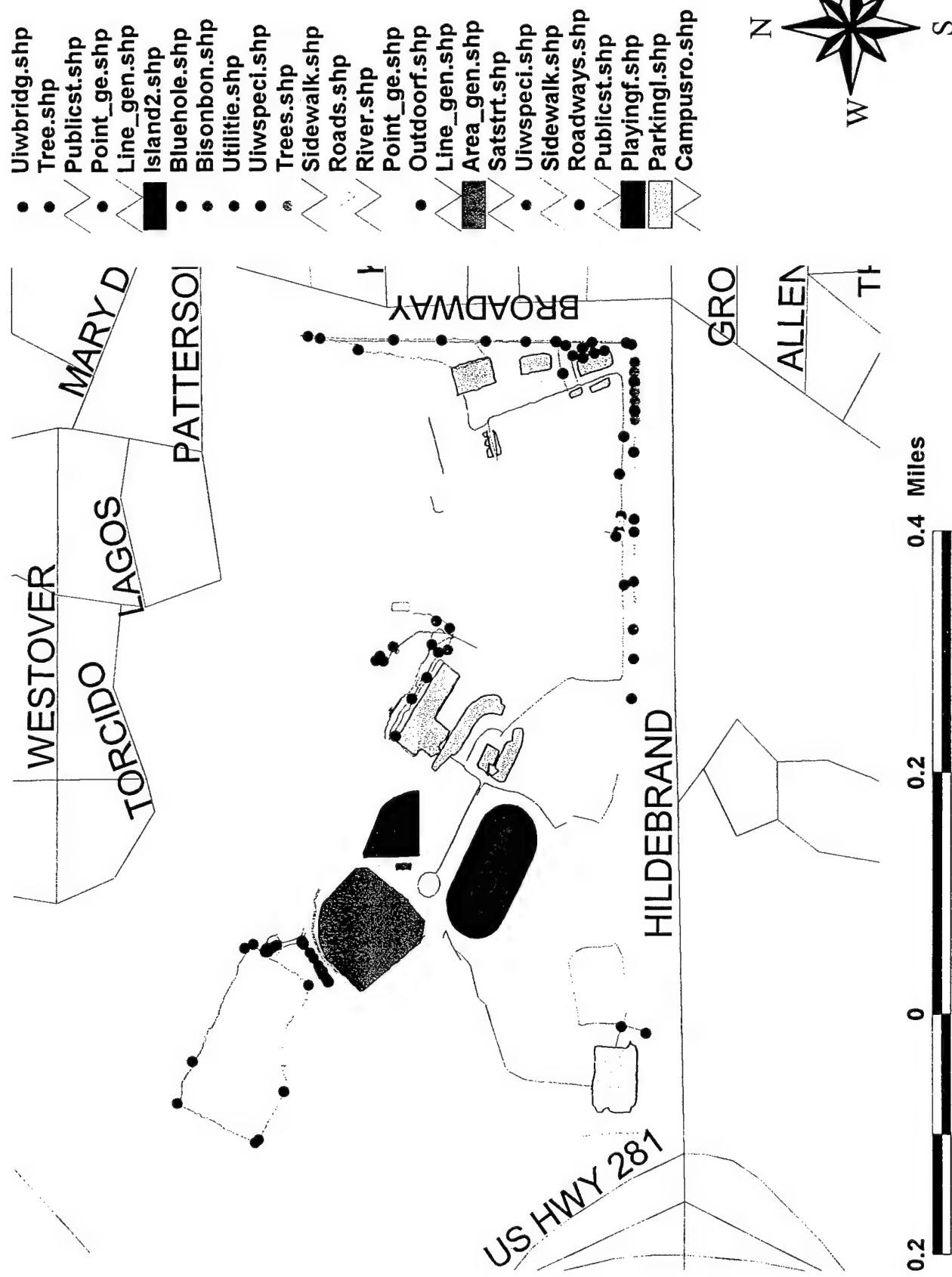
Course Description: Field Research in Environmental Science is an upper-level course which examines environmental problems most relevant to South Texas, introduces students to the public and private agencies that are attempting to solve these problems and the methodologies they apply, and provides training in the use of environmental equipment. Particular emphasis will be placed on the application of Global Positioning System (GPS) and Global Information System (GIS) technology to assessing and monitoring the environment.

Course Outcomes: I. Knowledge of environmental issues of greatest relevance to South Texas. II. Knowledge of local, state and federal environmental agencies, and their interdependent roles in environmental conservation, monitoring and reclamation. III. Experience with EPA environmental assessment methods. IV. Expertise with the use of GPS and GIS technology to construct maps, design experiments, and produce reports.

Grading:

Quizzes	25%
Participation	25%
Preliminary GPS/GIS project	10%
Agency assignment and report	40%

CLASS PROJECT OF UIW



C:\pfdata.classproject

Appendix III

Course Syllabus for Instrumental Analysis – CHEM 4322

Sample Laboratory Procedures used in Instrumental Analysis Course

Chemistry Research Syllabus

**University of the Incarnate Word
CHEM 4322, Instrumental Analysis
Syllabus**

Catalog Description:

Basic electronics, electrochemistry; spectroscopic methods of analysis including IR, UV-Vis, NMR, AAS, AES; gas and liquid chromatography. Laboratory problems utilizing procedures covered in the lecture.

Context:

Prerequisite: CHEM 2301, 2302, 2201, 2202, 3421

Course Intent: This course is designed to teach theory of different analyses, sources of error, and laboratory accuracy and precision.

Description of Course:

Objectives:

Students will recognize sources of error and methods to eliminate errors.

Students will learn the theory of different types of analyses including chromatography, spectroscopy and electrochemistry.

Students will learn abilities of instrumentation.

Students will learn practical uses of instrumentation.

Students will be expected to respond to questions in clear and precise language whether the response is oral or written.

Requirements:

Students will need a scientific/engineering calculator. Such a calculator includes the functions log, ln, e^x and EE (scientific notation).

Outcomes

This course is expected to contribute toward meeting the Chemistry Program Student Outcomes.

Chemistry Program Outcomes are that

Students will be able to understand functions and abilities of different instruments.

Students will be able to perform instrumental analyses.

Students will be able to design their own project and present the results.

Experiment 9 : Raw Material Analysis

The analysis of the raw material includes the following tests:

residue on ignition (ROI)

loss on drying (LOD)

chromatographic purity

Save time when you are using the HPLC in Experiment 10 to do the chromatographic purity.

The raw material we will be analyzing is caffeine. Caffeine is $C_8H_{10}N_4O_2$ and has a molecular weight of 194.19 g/mol in the anhydrous form. The IUPAC name of the compound is much more challenging - 1*H*-Purine-2,6-dione,-3,7-dihydro-1,3,7-trimethyl-xanthine. Caffeine is anhydrous or contains one molecule of water of hydration. It contains not less than 98.5% and not more than 101.0% of $C_8H_{10}N_4O_2$, calculated on the anhydrous basis. The manufacturer will have done these tests already. Compare your results to theirs.

ROI

Weigh accurately 1 to 2 g caffeine in a suitable crucible that previously has been ignited, cooled, and weighed. Heat, gently at first, until the substance is thoroughly charred, cool, then moisten the residue with 1 mL of concentrated sulfuric acid, heat gently until white fumes no longer are evolved, and ignite at 800 (+25°C) until the carbon is consumed. Cool in a desiccator, weigh, and calculate the percentage of residue. If the amount of the residue so obtained exceeds 0.1%, again moisten the residue with 1 mL of concentrated sulfuric acid, heat and ignite as before and again calculate the percentage of residue. Continue the ignition until constant weight is attained.

Conduct the ignition in a well-ventilated hood, but protected from air currents and at as low a temperature as is possible to effect the complete combustion of the carbon. A muffle furnace may be used and is recommended for the final ignition at 800 (+25°C).

LOD

Dry a sample of caffeine at 80°C for 4 hours in a container which has been dried to constant weight. The anhydrous form of caffeine loses not more than 0.5% and the hydrous form not more than 8.5% of its weight. Make sure that you use a large enough sample that you can detect a loss of less than 0.5%.

Chromatographic purity (rather modified from real life)

Make a solution of caffeine in the mobile phase you'll be using at a concentration twice that which you expect to be in the final product (Mountain Dew). What concentration do you expect (mM or M)? Inject this solution into the HPLC. If you get only one peak, the raw material has passed this purity test.

If you get other peaks (buried in the baseline and looking like noise), assume that the response factor is the same for these impurities as it is for the caffeine and calculate the concentration of the impurities.

Pre-lab

See if you can find what the concentration of caffeine is in Mountain Dew or Pepsi. There may be suggested experiments in education journals, textbooks, or the internet. You could also call the company. Turn in the value you find to me before you do this experiment.

Experiment 10: Analysis of Final Product

The following report (which will also serve as directions) is patterned after a common report form used in industrial applications. Your report form for this experiment should follow this format. You will need to do your own calculations as to what percentage of the target concentration the calibration curve covers, what percentage of the target concentration the recovery study represents, and so forth. Numbers are included in the following report but they may not be the numbers you will use.

Extract only the parts of the following "Technical Report" which are relevant to what your group did. Don't try to get the information from the other groups in order to write a full report. They'll tell you what they did and how they did it in the oral presentations.

Summary:

The following Technical Procedure is shown to be suitable for the quantitation and identification of caffeine in a AAAA M formulation and is stability indicating. Data for two five-point calibration curves and two five-point vehicle calibration curves were collected. Each curve ranged from approximately BBBB - CCCC M which represents approximately a 25% to 150% of the labeled product concentration. For the calibration curves, the mean recovery, relative standard deviation and R-squared values for each curve are 100.8% and 100.9%, 0.7% and 0.5%, and 0.9999 and 0.9999, respectively. For the vehicle calibration curves, the mean recovery, relative standard deviation, and R-squared values are 100.7% and 100.6%, 0.88% and 0.83%, and 0.9999 and 0.9998, respectively. The mean recovery and the relative standard deviation for the two sets of vehicle replicates are 100.5% and 100.9% and 0.5% and 0.3%, respectively.

Signature:

Position:

I. Introduction

The following procedure is shown to be suitable accurate, rugged, sensitive and precise for the assay and determination of caffeine in a formulation (AAAA M).

A. Calibration Curves

Two five-point calibration curves and two five-point vehicle calibration curves were prepared in duplicate. The curves were found to be linear over the specified range, pass near the origin, and have good recoveries.

B. Vehicle Replicates

Two sets of eight vehicle replicates were analyzed. Analysis show that both sets exhibited good recoveries, precision and accuracy.

C. Degradation Studies

Forced degradation of vehicle standards, vehicle blanks, and degraded vehicle spiked with caffeine (you won't be doing this last step. I just included it to show pharmaceutical standards) were performed. Degradation of the caffeine was detected in vehicle standards without interferences. Degraded vehicle blanks gave no interferences.

II. Experimental

A. Calibration curves

Data points for the five-point calibration curves and vehicle calibration curves, prepared in duplicate, were obtained. The standards were made by transferring appropriate amounts of a caffeine standard solution (DDDD M) to (25 or 50) mL volumetric flasks. The vehicle standards included a ten-fold dilution of the vehicle. All solutions were then diluted to volume using the mobile phase. The mobile phase used in all HPLC experiments was a 50:50 mixture of methanol:water with the pH adjusted to pH 3.5 using HCl. All four calibration curves covered a range of about 25% to 150% of the target concentration in the formulation (AAAA M caffeine).

The final product (Mountain Dew) was diluted two-fold with the mobile phase and injected to determine its concentration.

B. Vehicle Standard Replicates

Two sets of eight vehicle replicates were prepared. The vehicle standard replicates were prepared by making a five-fold dilution of the caffeine standard stock solution (DDDD M) and a ten-fold dilution of the vehicle. The samples were then diluted to volume with mobile phase.

The two sets of aqueous standards were similarly prepared by making a five-fold dilution of the caffeine standard stock solution (DDDD M) and diluting to volume with the mobile phase. This procedure represents 10% of the target concentration in the formulation.

C. Vehicle Degradations

Data for the stressed vehicle degradations were collected using five different conditions: heat, heat + acid, heat + base, heat + peroxide, and light. The solutions for the vehicle standard degradation included a five-fold dilution of the caffeine standard stock solution (DDDD M) and a ten-fold dilution of the vehicle.. The solutions for the vehicle blank degradation included a ten-fold dilution of the vehicle and a ten-fold dilution of water. A flask from each of these two sets were treated in the following manner.

1. Heat for 1 hour at 90°C.
2. Added concentrated HCl (in the ratio of 0.100 mL/10.0 mL. Keep this proportion for whatever sample size you choose) and heated for 1 hour at 90°C.
3. Added (0.5 mL 3 M NaOH in total of 10.0 mL or this proportion for your sample size) and heated for 1 hour at 90°C.
4. Added (0.100 mL 30% H₂O₂ in total of 10.0 mL) and heated for 1 hour at 90°C.
5. Exposed to ultraviolet radiation for 15 minutes.

The samples were allowed to cool to room temperature and the acid and base solutions were neutralized. Once the solutions were cooled to room temperature, they were diluted to volume with mobile phase.

III. Calculations

A least square fit for both sets of calibration curves was performed. The recoveries for the caffeine for the vehicle standard curve, replicates and degradation studies were calculated using the following equation.

$$\% \text{ Recovery} = \frac{A_s}{A_{\text{std}}} \times \frac{C_{\text{std}}}{C_s} \times 100$$

A_s = response (area units) of the vehicle standard
 A_{std} = response (area units) of the aqueous standard
 C_s = concentration of the vehicle standard
 C_{std} = concentration of the aqueous standard

IV. Results and Discussion

A. Calibration Curves

Each of the aqueous calibration curves were found to be linear over the specified range with R-squared values of 0.9999 and 0.9999, respectively. Each curve passed near the origin with y-intercepts representing 1.2% and 0.9% of the target response for the caffeine formulation. The mean recoveries for the two curves are 100.8% and 100.9% with ranges from 100.1%-100.7% and 100.2%-100.9%, respectively. The relative standard deviation (RSD) of the recoveries for each curve was determined to be 0.7% and 0.5%, respectively.

Each of the vehicle calibration curves exhibited recoveries, RSDs and R-squared values of 100.7% and 100.6%, 0.88% and 0.83%, and 0.9999 and 0.9998, respectively. Each curve is linear with y-intercepts representing 0.4% and 0.6% of the target response for the caffeine formulation. The criteria for a single-point standardization are R-squared ≥ 0.975 with intercepts $\leq 5.0\%$ of the midpoint response. The data obtained for the vehicle curves meets these requirements; thus, this method is suitable for a single-point standardization. The data for the curves is presented in Tables 2 and 3 and Graphs 1-3.

B. Vehicle Replicates

Statistical analysis of the response factor (i.e., response/concentration) shows the vehicle replicates have a RSD of 0.5% and 0.3%, respectively. The mean recoveries for the replicate sets are 100.5% and 100.9%, respectively. These data are presented in Table 4.

C. Vehicle Standard Degradation Studies

Analysis of the degraded vehicle standards reveal degradation of the acid + heat, base + heat, peroxide + heat and light exposed standards with recoveries of 33%, 90%, 86% and 31%, respectively. No interferences from degradation products of analytes or other formulation components are observed with the analyte response in these studies. Thus, the method is stability indicating. The results are presented in Table 5 and the chromatograms are illustrated in Figures 1-5.

D. Vehicle Blank Degradation Studies

The vehicle blands were analyzed and were found to be free from possible interferences with the analyte response.

V. Conclusions

The methodology employed for the analysis of caffeine was found to meet the suitability requirements for validation. The method was shown to be accurate, precise, linear, specific and stability indicating for the assay of caffeine in the formulation (AAAA M).

VI. Data

- Table 1 - Formulation composition for a AAAA M caffeine product
- Table 2 - Caffeine calibration curves
- Table 3 - Vehicle calibration curves
- Table 4 - Caffeine vehicle replicates
- Table 5 - Degradation of caffeine vehicle standards
- Graph 1 - Caffeine calibration curve (1)
- Graph 2 - Caffeine calibration curve (2)

- Graph 3 - Vehicle calibration curve (1)
- Graph 4 - Vehicle calibration curve (2)
- Figure 1 - Heat degraded vehicle standard and blank
- Figure 2 - Acid degraded vehicle standard and blank
- Figure 3 - Base degraded vehicle standard and blank
- Figure 4 - Peroxide degraded vehicle standard and blank
- Figure 5 - Light degraded vehicle standard and blank

VII. References

1. Name, Laboratory notebook, p#.
2. Name, Laboratory notebook, p#.
3. Name, Laboratory notebook, p#.
4. Name, Laboratory notebook, p#.
5. Labratory guide sheets

Table 1 - Formulation composition of a AAAA M caffeine product

Ingredients	Percent w/v
Caffeine	0.1%*
Phosphoric acid	0.5%
FD&C food coloring yellow #5	0.1%

*Omitted from validation vehicle.

You can at least list the ingredients if not the percent composition.

Table 2- Caffeine calibration curves

Concentration ($\mu\text{g/mL}$) (do this in M)	Area response units	Response/ Concentration area/(M)	% Recovery
25.78	165798	6431	100.7
25.78	162360	6298	98.6
51.56	332834	6455	101.1
51.56	335211	6501	101.8
77.34	500973	6478	101.5
77.34	500151	6467	101.3
103.1	660202	6404	100.3
103.1	663094	6432	100.7
154.7	988826	6592	100.1
154.7	992745	6417	100.5

Mean recovery = 100.8%

Mean response factor = 6427 area units/($\mu\text{g/mL}$)

R-square = 0.9999

RSD of the recovery = 0.7%

Slope = 6399 area units/($\mu\text{g/mL}$)

Y-intercept as

percent of mid-point concentration

Include a second table for the second calibration curve data.

Table 3 - Vehicle calibration curves

Concentration ($\mu\text{g/mL}$) (do this in M)	Area response units	Response/ Concentration area/(M)	% Recovery
25.78	165798	6431	100.7
25.78	162360	6298	98.6
51.56	332834	6455	101.1
51.56	335211	6501	101.8
77.34	500973	6478	101.5
77.34	500151	6467	101.3
103.1	660202	6404	100.3
103.1	663094	6432	100.7
154.7	988826	6592	100.1
154.7	992745	6417	100.5

Mean recovery = 100.8%

Mean response factor = 6427 area units/($\mu\text{g/mL}$)

R-square = 0.9999

RSD of the recovery = 0.7%

Slope = 6399 area units/($\mu\text{g/mL}$)

Y-intercept as = 1.2%

percent of mid-point concentration

Include a second table for the second calibration curve data.

Table 4- Caffeine vehicle replicates

Concentration µg/mL	Response area units	Response /concentration area units/(µg/mL)	% Recovery
105.5	4929785	46728	100.1
105.5	4945727	46879	100.5
105.5	4920775	46642	100.0
105.5	4942923	46852	100.4
105.5	4993761	47334	101.4
105.5	4926044	46692	100.1
105.5	4948356	46904	100.5
105.5	4962608	47039	100.8

Mean % recovery = 100.5%

Mean response factor = 46883 area/(µg/mL)

RSD of the recovery = 0.5%

Include a second table for the other data set

Table 5 Degradation of Caffeine Vehicle Standards

Conditions	Vehicle standard % recovery	Vehicle blank % recovery
Heat	99	NIDPO
Heat + acid	33	NIDPO
Heat + base	90	NIDPO
Heat + peroxide	86	NIDPO
Light	31	NIDPO

NIDPO = No interfering degradation product observed

Memorandum

From: Dr. S. B. Kong, Chemistry Department, College of Arts & Sciences
Phone: 829 3146, Fax: 829 3153
e-mail: kong@universe.uiwtx.edu

To: **Undergraduate Students in chemistry Research**
Re: **Chemistry Research Subjects for the fall, 1999, University of the Incarnate Word(UIW), San Antonio, Texas.**

Dear Students,

You may pick up one of the topics below and work with me through the summer 1999. Make an appointment and we will discuss the subject in detail. I need your e-mail address, telephone number and home address. You should come to see me or call me on the subject of your choice.

Here is our schedule for the fall. Give me a call if you have to change the schedule.

This semester, we will join Trinity University seminar series as a regular Friday meetings. There are 7 seminars recommended for you to attend. You are required to show up for all 7 meetings.

We also will meet at regular seminar hours as follow for your presentation:
November 13, 1999 Friday 12:20 – 1:30 pm at Science Hall Conference Room
Open Discussions on the subjects. Practice run.
November 20, Friday 12:20 – 1:30 pm same room
Presentation. 20 minutes: 15 minutes talking, 5 minutes discussion.

Poor report, unprepared presentation, missing appointments and absences without proper excuses will cause a poor grade or failure of the class.

Subjects:

1. Science reference search through STN and INTERNET. Computer library search for chemistry, biology, environmental science and other subjects.
2. Studies on drugs affecting central nerve system.
Pharmacology and synthesis of amphetamine, LSD and morphine derivatives.
3. Studies on Omeprazole, an ulcer drug: mechanisms and synthesis.
4. The chemical components of Crustacean including crawfish and their possible use. Why do shrimp, crab and lobster have a pink color when cooked? Where do you use Chitosan?

5. Polyaromatic hydrocarbons as carcinogenic suspects. Petroleum and automobile gas exhaust analysis.
6. UV absorbers in commercially available suntan lotions as cancer causing agents. What kind of chemicals do we use in the summer to protect from hazardous sunlight?
7. Insecticides from the natural products. What is safer insecticide?
8. Fungicides from the natural products.
9. Nematicides from the natural products.
10. Herbicides from the natural products.
11. Purification of drinking water. Chemistry of ion exchange column and its application.
12. Pesticide residue analysis of drinking water and food. Gas Chromatography-Mass Spectrometer (GC-Mass) analysis.
13. Toxic chemical disposal problem in industry.
14. Analysis of food, Nitogens(amino acid, nitrosoamines), vitamins, fats, carbohydrates.
15. What is prostaglandins? Their chemistry and effects.
16. Male birth control pill studies.
17. Food Flavors: biology and chemistry. What are the chemical components of food smell? Flavor and food interactions.
18. Flavor and lipid chemistry of seafoods.
19. Fruit flavors: natural fruit flavors, aromas and essential oils. Biochemical pathways also can be included.
20. Chemistry of fragrant substances. Perfumes and flavor materials from artificial and natural origin.
21. Naturally occurring antioxidants. What is the relationship between aging process and antioxidant mechanism of animals?
22. Chemical communications of insects.
What is insect pheromone? What is kairomone?

23. Plant hormones including growth hormone(IAA).
24. Liquid Chromatography – Gas Chromatography (LC-Mass) and its application.
25. Chemical taxonomy of plants.
26. Chemical taxonomy of insects.
27. Snail Chemistry. Moluscicides.
28. Human brain and psychology. What is blood brain barrier(BBB)? What kind of chemicals pass through BBB and affect our mental system? How do scientists study brain chemistry?
29. South American folk medicines other than Mexico
30. Mexican folk medicines
31. Texas folk medicines.
32. Mushrooms: Toxic toadstools and edible ones. Chemistry of toxic chemicals in mushrooms.
33. Marine chemistry: Choose one of the subjects.
34. Metabolite studies with Radioisotopes.
35. Any other interesting subjects you would like to discuss with Dr. Kong?

The grade will be based on 1) The report, 20 pages, typed, double space, 10 pages of them could be tables and figures. The grading scheme is as following; A>90, B>80, C>70, D>60 and F below 60. 2) Presentation: you are required to give a seminar presentation, 15 minutes speech, 5 minutes discussion. You may use a) overhead transparency , Computer projector or a slide projector. Let me know a little in advance what you need to present your paper. The grading scheme is the same as 1).

The report and the presentation should follow the format as below:

1. Abstract (less than 1 page)
2. Introduction
3. Research (should begin with library search and websites and come to see me for your topics)
4. Results and discussion
5. Conclusion
6. References

Bibliography

The following bibliography were used in the Field Research in Environmental Science (ENVS 4371.2) course.

Environmental Science, 4th ed., by Jonathan Turk and Amos Turk, Saunders College Publishing, 1988, 712p.

Environmental Geology, 3rd ed., by Carla W. Montgomery, W.C. Brown Publishers, 1992, 466p.

Environmental Geology, 6th edition, by Edward A. Keller, (1992), Macmillan Publishing Co., 521p.

Essentials of Soil Mechanics and Foundations by David F. McCarthy, Reston Publishing Co., Inc., (A Prentice Hall Co.), 1977, 505p.

Geology and the Environment, by Bernard W. Pipkin, West Educational Publishing, 1994

General Geology for Engineers, by Alan E. Kehew, Prentice-Hall, Inc., 1988, 447p.

Principles of Engineering Geology, by Robert B. Johnson and Jerome V. DeGraff, John Wiley & Sons, Inc., 1988, 497p.

Soil Survey of Bexar County, Texas by F.B. Taylor, R.B. Hailey, and D.L. Richmond, U.S. Department of Agriculture, Soil conservation Service, Series 1962, No. 12, 1966, 126p.

Stream Hydrology, An Introduction for Ecologists by Nancy D. Gordon, Thomas A. McMahon, and Brian L. Finlayson, John Wiley & Sons, Inc., 1992, 526 p.

Volunteer Stream Monitoring: A Methods Manual, EPA 841-B-97-003. U.S. Environmental Protection Agency, Office of Water, Washington D.C. 20460, 1997, 210